tional forces, but the latter come into action with velocity, while the former come into play with acceleration." On page 152 he states that "both forces and kinetic reaction must be the same type of magnitude."

These statements, together with others, seem to indicate that the author considers kinetic reaction as something real and of the nature of a force. In fact it is a force, although the author on page 150 states that kinetic reaction can not be called a force because we have restricted the latter term to the action of one material body upon another. Call it what we will, to the reviewer it seems to be nothing more nor less than a backward pull of the ether on a body as the body moves through the ether with accelerated motion. In fact, the author seems to say that the inertia of a body is due to the force with which the ether is pulling back on a body when the body is being accelerated.

Assuming that the author's conception of kinetic reaction is here correctly given, the reviewer is inclined to believe that several questions will at once present themselves to the readers of his book.

Why is it that the ether acts on a body only when it is being accelerated and not when the body is moving with constant velocity?

If kinetic reaction is the action of the ether on a particle, and if it is the same kind of a quantity as force (is a force in fact), and if the resultant force F acting on a particle and the kinetic reaction q are always equal in magnitude but opposite in direction (both equal to ma in magnitude), why is the body not in equilibrium? The author recognizes this difficulty in a footnote (page 153) by stating in effect that we must not call kinetic reaction a force, for if we do then the vector sum of all the forces acting on a particle will always equal zero without this particle necessarily being in equilibrium, a state of affairs which is not consistent with the condition of equilibrium of a particle. Refusing to call kinetic reaction a force, however, in order to keep out of trouble simply dodges the question and does not answer it.

The reviewer does not wish to say that the author is wrong in his conception. All he wishes to say is that he entirely fails to appreciate the author's point of view.

There is considerable difference between the author's action principle and D'Alembert's principle. Let there be a number of forces acting on a particle, then the resultant force (an ideal force) equals ma, or $R = ma$. This ideal force may be called the effective force. D'Alembert's principle then says that a system of forces acting on a particle together with the reversed effective force will form a system of forces in equilibrium. It should be remembered that this reversed effective force is an ideal force and not a real force. Now in the author's action principle the kinetic reaction is a real force (or action as the author prefers to call it) and is due to the action of the ether on a particle.

The author's action principle (even if sound) involves a number of conceptions which must be understood in order to understand the principle itself, and it seems that such a principle ought to follow rather than precede an elementary treatment of mechanics.

E. W. RETTGER

ITHACA, N. Y.

SPECIAL ARTICLES

EXPERIMENTAL ABLATION OF THE HYPOPHYSIS IN THE FROG EMBRYO

IN the following preliminary paper the effect of the extirpation of the epithelial portion of the hypophysis upon the subsequent growth and development of tadpoles is summarized. The work was first attempted in 1914, *Diemyctylus torosus* being used, repeated in 1915 upon *Rana pipiens,* and again repeated in 1916 upon *Rana boylei.* In this paper the results obtained with *R. boylei* are reported.

The operation was most successfully carried out upon approximately 3 mm. larvæ, at which time the tail-bud is forming and the stomadeum can be detected. At that stage the epithelial hypophysial invagination can be accurately determined from the pit that it forms, or from its location between the protuberance of the forebrain and the stomadeum, and can be removed without injury to the adjacent brain.

This epithelial ingrowth was removed with some neighboring epithelium. The wound healed within three hours, less than 1 per cent. of the larvæ disintegrating after the operation. About 200 larvæ of the 3 mm. stage were operated upon, the hypophysis being successfully removed in over 60 per cent. of the cases. Approximately 30 per cent. of those animals in which the gland was extirpated did not give reliable results in the rate of growth as the mouth was wholly or partially removed thus interfering with feeding. For checks, unoperated specimens and those in which the ablation of the gland was unsuccessfully attempted were available. The operated animals and checks were kept in boiled water for five days and then transferred to a frog tank where they were in an essentially normal environment.

The hypophysis-free animals grew more slowly than the normal controls. No hypophysectomized animals reached the size of the largest checks and the averages of the two show a noticeable difference. On June 6 the operated but not hypophysectomized animals had an average length of 40–43 mm., the hypophysis-free animals averaging 33–35 mm. A ratio such as this prevailed throughout their growth. The ratio of body to tail length is the same in the two classes, the difference in size being uniform for all parts of the animal.

Differences in color began to be noticeable at an early stage. From then on the contrast in pigmentation between the hypophysectomized animals and the checks was striking. Those animals without a hypophysis had a slightly darkened silvery appearance of an almost uniform character; however, the dorsal side was more pigmented than the ventral. These are referred to as albinos. The checks were a brown-black color often showing a mottling. This color difference was more noticeable over the body than on the tail, but was evident in both regions and was the most striking feature up to the time when the hind legs began to appear in the checks. Sections show that in the albinos the epidermis is pigment-free while that of the checks is filled with it. The subcutaneous pigment is present in the albino in as great a quantity if not greater than in the normal animal. The retinal pigment appears to be the same in both.

The hind leg buds appear, normally, when the tadpole has reached a length of 25–27 mm. In the albino the hind limb buds appear but slightly later than in the checks or when they are from 26–28 mm. in length. From this stage on, however, the hind limbs in the hypophysectomized animals grow but little if at all, although their total length increases at a rate but slightly under the normal one. For instance in 28 mm. checks the hind legs average 1.0 mm.; in 30 mm. checks 2.0 mm.; in 38 mm. checks 4.0 mm. In the albinos of each of the above sizes and ages the hind legs were 0.1 mm. long. The above is in accord with Adler ('14),[1] who found that the removal of the hypophysis in a 20 mm. stage inhibited the growth of the hind legs.

Sections of the albino and normal animals show striking contrasts in the organs. Of the specimens yet sectioned none described above as albino or hypophysectomized have had a trace of the anterior lobe of the hypophysis present. Thus it is certain that the entoderm has not the intrinsic power to form a hypophysis, but that if it enters into the formation of the gland at all it must be considered as a tissue inclusion which may become changed through its adaptability into glandular parenchyma, a conclusion previously drawn by the writer Smith ('14).[2] Comparison with the checks shows that the infundibulum undergoes structural modifications, although the saccus vasculosus, as far as determined, appears to be normal. In the checks that region of the diencephalon which rests against the pars glandularis is of considerable thickness, having in addition to the ependyma a rudimentary pars nervosa. Caudad to this the wall is formed almost entirely of ependyma. In the hypophysectomized animals the pars nervosa

1 Adler, L., "Metamorphosestudien an Betrachierlarven. I. Extirpation endokriner Drüsen. *A.* Extirpation der Hypophyse," *Arch. f. Entwickelungsmech. d. Organ.*, Bd. 39, 1914.

2 Smith, P. E., "The Development of the Hypophysis of *Amia calva*," *Anat. Rec.*, Vol. 8, 1914.

is reduced throughout most of its extent to an ependymal layer. Small localized thickenings may occur but nothing corresponding to the normal animal.

The difference in size and structure between the thyroid of an albino and that of a check is very marked. The thyroid of a normal 38 mm. tadpole with 4.0 mm. hind legs is approximately three times the size of a 37 mm. albino with 0.1 mm. hind legs. The compactness and character of the parenchyma show an even more striking contrast. A sagittal section through the thyroid of a 38 mm. check shows on an average 15–18 vesicles, many of which are largely distended with colloid, the parenchyma of the whole gland being compacted together, as compared with that through the thyroid of a hypophysectomized 37 mm. specimen which shows 4–5 atrophied vesicles containing but a slight amount, or no colloid, and with large spaces between the vesicles. The cells making up the vesicles of the former are cuboidal and protoplasmic-rich, in the latter little but nuclei remain. The results obtained from the experimental feeding of thyroid by Gudernatsch and others makes it highly probable that the non-development of the hind legs in the albinos is due immediately to the atrophy of the thyroid and not to the direct action of the hypophysis, a suggestion which Adler's work upon the tadpole also supports.

An examination of the gonads shows significant size differences between the normal and albino specimens. In the hypophysectomized animal the development of the sex glands is apparently much retarded and the size correspondingly reduced.

The author in a later and more complete account will describe any changes which may be found in the other endocrine glands and treat of the progressiveness of the changes noted.

P. E. Smith

Anatomical Laboratory,
University of California

EFFECT OF GRINDING SOIL ON THE NUMBER OF MICROORGANISMS

In connection with a study of the bacterial content of soil, it was found that pulverizing soil in a ball mill seriously affected the number of bacteria. This treatment not only reduced greatly the bacteria, but also that of many other microorganisms. In many cases the soil was partially air dry and contained clumps which were not easily broken by shaking in a water suspension. Because of the mass of soil particles, it was thought that perhaps grinding would result in a higher count. From the results below, it will be seen that such was not the case. Instead of a gain, there was a loss in number of organisms which was more marked the longer the soil was ground.

The test was made as follows: Fresh or partially air-dried soil, containing not more than 10 per cent. moisture, was placed in a ball mill partly filled with large pebbles. The mill was geared so that the porcelain jar revolved at the rate of 70 revolutions per minute.

TABLE I

A COMPARISON OF THE NUMBER OF BACTERIA IN GROUND AND UNGROUND SOIL

Test No.	Date	Soil	Bacteria in One Gram of Dry Soil		
			Unground	Ground	Time of Grinding, Hours
1	April 4	Miami silt loam	4,225,000	3,439,000	1
2	April 5	Red clay	626,000	570,000	1
3	April 6	Fine sand	216,000	198,000	1
4	April 11	Black silt clay loam	3,300,000	2,200,000	1
5	April 12	Colby silt loam	1,200,000	1,800,000	1
6	April 13	Carrington silt loam	2,000,000	400,000	1
7	April 14	Sandy loam	1,200,000	300,000	1
8	April 18	Medium sand	362,000	186,000	1
9	April 19	Plainfield loam	264,000	174,000	1
10	April 20	Muck	2,064,000	1,746,000	1
11	April 26	Miami silt loam	44,602,000	10,540	8
12	May 3	Garden soil	3,194,000	5,610	8
13	May 4	Garden soil	3,194,000	75	24

The following results, shown in Table I., illustrate the difference in the number of bacteria in the ground and the unground soil, as well as the effect of time of grinding on the number of bacteria. Grinding greatly reduced the number of bacteria except in one case, No.